Society for Chaos Theory in Psychology & Life Sciences

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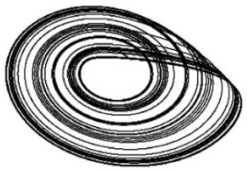
Abstracts to the 23rd Annual International Conference, Portland OR

2013



Society for Chaos Theory in Psychology & Life Sciences

23rd Annual Conference
Portland State University, Portland, Oregon
July 25-27, 2013

Alphabetical List of Authors & Abstracts[1]

John Balwit , Portland State University

Suicidal Aid: An Existence Proof for Positive Selection for Cooperation in the Absence of Inclusive Fitness

Evolutionary biologists concerned with the evolution of cooperation are engaged in a vigorous debate between a perspective of inclusive fitness (researchers favoring versions of Hamilton s kin selection) and a perspective featuring multiple mechanisms for including group selection, spatial selection, reciprocity and others. Very broadly, those researchers advocating for the predominance of the inclusive fitness deny that cooperation (or altruism) might arise in any context other than benefit to kin. This paper and the agent-based model that it describes offers an existence proof to the contrary. In this model suicidal altruists die and release a chemical that diffuses in the immediate neighborhood. A complementary species (but not the altruists own species) benefits from the altruism. Spatial selection plays an important role in supporting the emergence and proliferation of cooperation in this model. The model also offers opportunities to consider the ontological status of systems and sub-systems that exhibit cooperation.

Najia Bao,
The Fu Foundation School of Engineering and Applied Science, Columbia University;
B & B Institute of Human Brain Potential
Nangui Bao,
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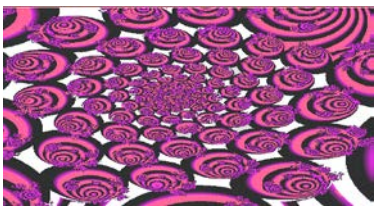
Research on Brain Chaos by EEG

Objective: Do electroencephalography (EEG) recording of healthy people and quantitatively analyze the variation of EEG chaotic states during intense mental activity. Participants and Methods: Two engineers voluntarily participated in the experiment as subjects. Both of them are healthy. Subject 1 is an old engineer (male, exuberantly creative and quick thinking). Subject 2 is a young engineer (female, good at thinking and rich imagination). Two sets of questions with 15 items per set are similar to Graduate Record Examinations (GRE) quantitative/math section in USA. Two standards for time limitation: 15 minutes for the first set and 7.5 minutes for the second one. No pencil or calculator is allowed. Results: Percent of correct responses from old engineer is: 100% for the first set and 93.3% for the second one. Percent of correct responses from young engineer is: 100% for the first set and 100% for the second one. The results of EEG analysis show that young engineer is better than old engineer in both process in short-term memory and retrieval from long-term memory. There is no significant difference between two engineers' imaginative power. But the old engineer s metacongitive ability is superior to the young engineer's. Conclusions: The brain is a complex nonlinear dynamical system. The human brain exhibits stable chaotic behavior, which is actually a state of equilibrium. Chaos, to a certain extent, reflects healthy dynamics. EEGs, which reflect the electrical activity of the brain, can effectively represent the change of its physiological states. In this research, the classical tools of nonlinear dynamics, including power spectrum, Lyapunov exponents spectrum, Correlation Dimension and Kolmogorov entropy, were applied in analyzing the variation of EEG chaotic states of healthy people during intense mental activity. In this research, we combine energy transfer hypothesis in chaotic motion with EEGs data analysis in order to open vast prospect for the prevention and treatment of brain diseases like Alzheimer s and the development of human brain function.

Najia Bao,
The Fu Foundation School of Engineering and Applied Science, Columbia University; 2. B & B Institute of Human Brain Potential
Nangui Bao,
B & B Institute of Human Brain Potential

Quantitatively Determine the Developing Level of Right Brain Potential by EEG

Objective: The purpose of this experiment is to open up a path for theory research and to guide practice of the development of brain potential. Participant: The subject is a 73 year-old educator (male and healthy). Methods: Two sets of sample questions (same difficult level with 10 items per set) are similar to Fundamentals of Engineering (FE) Exam morning-session. Two standards for time limitation: 20 minutes for the first set and 15 minutes for the second one. No pencil or calculator is allowed. FE exam covers a comprehensive range of 15 subjects such as Mathematics, Chemistry, Engineering Mechanics, Electricity, and etc., as taught in an undergraduate engineering program. Results: Percent of correct responses from the subject is: 100% for the first set and 93.3% for the second one. The results of electroencephalography (EEG) analysis show that the subject could switch effort-requiring process and storage in working memory to highly efficient episodic memory encoding and retrieval, which was sustained by right prefrontal and medial temporal areas. This means his mental activity includes not only logical thinking but also imagery thinking. Conclusions: Although a number of projects on developing brain functions have demonstrated immediate benefits, only a few of them, such as Project TEGE, produced a lasting effect. Project TEGE focused on a program "training math in the dark", the purpose of which is to promote children's attention and imagine so that their minds are more receptive to learning math. It is surprisingly found from the results of long-term following up that not only children (trainee) but also adults' (trainer's) right brain function have been developed. The 73 year-old subject in this study is a participant (trainer) in the program "training math in the dark". EEG dynamic analysis, an effective noninvasive approach, contributes to quantitatively determine the level of development of right hemisphere potential and its lasting positive effects after people have participated in some training program on developing human brain potential.



Vincent Berardi, Computational Sciences, San Diego State University.
Ricardo Carretero, Applied Mathematics, San Diego State University.
Melbourne Hovell, Public Health, San Diego State University.
Antonio Palacios, Applied Mathematics, San Diego State University.

A New Model for Behavioral Interventions

Technological advances have led to personalized, data-intensive behavioral interventions that require continuous, individual-level models that stand in contrast to typical, discrete, group-level analyses. We discuss a nonlinear dynamical systems model based on the principles of operant behavior and their recent extension to population behavior in the behavioral ecological model. Our model describes changes in the behavior of individuals living in households where children are passively exposed to adult tobacco smoke. Time-dependent, sigmoid probability density functions (pdfs) describing the likelihood of indoor cigarette smoking behavior are developed. Monte Carlo simulations are then performed to produce a smoking activity time-series. Each home under consideration has been equipped with an air quality monitor, which allows household-specific model parameters based on real and real-time data to be determined. The monitors also provide visual and audio feedback when the air quality exceeds a threshold. The model assumes the feedback initiates reinforcement and punishment contingencies operating on multiple social levels that dynamically affect the pdfs. We demonstrate a correlation between model predictions and air-quality data for the frequency of indoor cigarette-smoking events. Further development of the model may allow future behavioral interventions to be adaptive, i.e. automatically respond to real-time conditions. This modeling approach represents an interdisciplinary collaboration between computational and public health scientists. It advances beyond typical models that depend on central tendencies (i.e. mean) by providing a basis for understanding a unique individual's behavior and how to change it.

Jonathan Butner, University of Utah.
Cynthia Berg, University of Utah.
Brian Baucom, University of Utah.
Deborah Wiebe, University of Texas Southwestern Medical Center

Modeling Coordination in Multiple Simultaneous Latent Difference Scores for Four Measures of Diabetes Regulation

Coordination is a taxonomy on how processes change together through time. It depicts the changes of two or more outcomes in terms of how synchronized they appear (from desynchrony to entrainment to synchrony) and the type of synchrony (e.g. one to one, two to one, in phase, anti phase). By capturing coordination as a latent variable with change as the manifestations from latent difference score models in structural equation modeling, one can fully differentiate all possible coordination patterns; entrainment occurs when there is a cogent latent coordination factor but predictable variability remains in the manifest changes and phase-locking occurs when all of the predictable manifest changes is captured by the coordination factor. Furthermore, one can then expand coordination beyond the two outcome case to test arrangements of underlying coordination mechanisms or patterns. Examples using two simultaneous latent difference score models and four simultaneous latent difference score models illustrate this approach within the context of adolescents and parents regulating type 1 diabetes. The four simultaneous latent difference score model suggests separate coordination components for parental regulation (mother and father monitoring) and self-regulation (adolescent self-efficacy and adolescent self-control). The parental regulation portion implies entrainment (in a 1 to 1.38 ratio of change) while the self-portion is phase locked (in a 1 to .3 ratio of change). This approach holds promise as a general statistical method for identifying the form of coordination for any number of simultaneous time series.

Din Chen, University of Rochester.
Jim Chen, Wayne State University.
Feng Lin, University of Rochester.

Statistical Power Analysis for Guastello's Polynomial Cusp Catastrophe Model: A Simulation-Based Approach

Popularized in the 1970's by Thom (1975) and colleagues, catastrophe theory was proposed to understand a complicated set of behaviors including both continuous and catastrophic changes. Operationalized by Guastello (1982) with a polynomial regression approach, this Guastello's polynomial cusp catastrophe model has been used extensively to model the nonlinear behaviors. However from design point of view, the associated statistical power analysis has never been investigated. In this presentation we propose a novel Monte-Carlo simulation-based approach to calculate the statistical power curve for Guastello's polynomial cusp catastrophe model so the sample size can be determined. With this novel approach, a power curve can be produced to depict the relationship between its statistical power and samples size under different model specifications. This power curve can then be used to estimate the sample size required for specified statistical power in design and analysis data from Guastello's polynomial cusp catastrophe model. The implementation of this novel approach is verified with simulated data and illustrated with real data from a study on modelling early sexual initiation among young adolescents. With this approach, researchers can compute statistical power and estimate sample size to conduct cusp modeling analysis using Gustello's polynomial regression method. Data needed for our methods included parameter effect size estimates and a data-model fitting error. With these data, power can be computed for any given sample sizes. Implementation of this simulation-based approach is in R software which is free available.

Xinguang Chen, Wayne State University
Bonita Stanton, Wayne State University
Din Chen, University of Rochester

Dual-process Systems Theory-guided Cusp Modeling of Adolescent Sexual Behavior Progression

Dual-process systems theory postulates two related brain systems for decision making. System 1 is heuristic, intuitive and experience-based, and accounts for the majority (~80%) of our behavior. System 2 is deliberative, logic, analytical and rule-based, and accounts for only a small portion (~20%) of our behavior. Consequently, behavior changes executed through System 1 are quick, sudden, and analytically seen as a discrete process while behavior changes operated through System 2 are gradual, smooth, and analytically seen as a continuous process. Until present, adolescent behavior researchers have succeeded in understanding System-2 based continuous changes but not System-1 based discrete changes in explaining health risk behaviors. This failure can be attributed at least in part to limitations of the commonly used analytical methods (e.g., regression or structural equation modeling) that are unable to quantify both continuous and discrete processes in one model. The cusp catastrophe model provides an alternative to overcome this methodological challenge. However, researchers using cusp models face another challenge: selection and allocation of predictor variables as asymmetry and bifurcation because of the lack of theoretical guidance. According to the dual-process systems theory, external and contextual factors (e.g., peer pressure, parental relationship) may best be modeled as bifurcation because they activate System 1 for sudden behavioral change while intrapersonal factors

(e.g., age, knowledge and skills) may best be modeled as asymmetry because they are essential for System 2. Guided with this theory, we analyzed data from 469 virgins (mean age = 11). Sexual progression index (SPI), the dependent variable, was determined by tracking these youth over a period of 24 months. SPI = 1 for a virgin with no intention to initiate sex, SPI = 2 for a virgin unsure about starting sex, SPI = 3 for a virgin who expects to initiate sex, and SPI = 4 for a person who has initiated sex. HIV knowledge (18 true/false questions, alpha=0.73) was modeled as asymmetry and peer pressure (3 items as a context measure, alpha=0.85) as bifurcation. Modeling results indicated that the SPI data fit the cusp model well (the cubic term $\beta1=0.1091$, $p < 0.01$; and the interaction term $\beta3 = -0.6652$, $p < 0.01$). HIV knowledge (interactive with SPI) and peer pressure ($\beta4 = 0.0906$, $p < 0.01$) significantly predicted SPI. The variances explained by the model was 80% compared to alternative linear models with R2 varying from 0.07 to 0.14. Conclusion: The dual-process systems theory provides a relevant guidance for researchers to advance the application of cusp catastrophe modeling in quantifying behavioral change. Further research is needed, including literature review and new data to confirm the role of dual-process systems theory in guiding the application of cusp modeling method in advancing adolescent behavior research.

Ann Clancy,
Appreciative Coaching Collaborative.

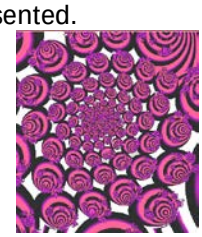
Self-Organizing Moments in Coaching: Revealing their Capacities and Power

According to William James, the greatest discovery of his generation was that humans could alter their lives by altering their attitudes of mind. This was revolutionary as the prevailing view of human change was Newtonian, therefore static and linear. A person was the sum total of his past with locus of control outside of himself. Extrinsic forces or causes made change happen and therefore could be controlled and planned. Since then, a new scientific paradigm emerged, including chaos theory, self-organizing processes, and Social Constructionism, which offers a radical shift in understanding. Now change can be viewed from a self-organizing perspective where the locus of control is intrinsic with moments of insight leading to significant changes in perception. The presenter is co-developer of the Appreciative Coaching model, based on Appreciative Inquiry, both founded on constructivism. A core principle underlying these approaches recognizes that individuals have the power to see themselves from the perspective of endless interpretive possibilities and to free themselves from limited patterns of thinking. In Appreciative Coaching, such shifts are viewed as pivotal moments. This interactive workshop is based on research by the presenter and her colleague who designed a hermeneutic/phenomenological study of their coaching work with twelve clients. Findings from the study show pivotal moments representing a range of self-organizing change, from learning shifts to transformations in perception. Coaches play a facilitative role in helping unleash the capacities and power of these pivots. Workshop participants will engage in activities applying coach priming strategies to real life situations from the self-organizing perspective.

Gregory Derry, Physics Dept., Loyola University Maryland
Paula Derry, Paula Derry Enterprises in Health Psychology

Chaos Theory and the Menstrual Cycle: Time Series Analysis Results

Human female reproductive endocrine physiology is a complex system with numerous interactive feedback loops relating hormones from the pituitary, ovaries, and hypothalamus. Empirically, menstrual cycle lengths show a high degree of variability that traditional models have not accounted for. The behavior of the system is also known to change with age, culminating in the cessation of menstruation at menopause, which is often preceded by a 5-10 year interval of increased variability (perimenopause). In earlier work, we tested our hypothesis that the menstrual cycle is a nonlinear dynamical system in a chaotic trajectory by doing time series analysis, using the menstrual cycle histories in the database of the Tremin Research Program on Women s Health as data. The results of that work will be reviewed briefly here. More recently, we have explored the age-related changes by measuring changes in the correlation dimension of the system as a function of the number of years prior to the final menstrual period, again using Tremin data (144 women, 47658 data points). Although some of the correlation dimension measurements are performed using familiar techniques (e.g. Grassberger-Procaccia method and Takens estimator), much of the work presented here features a less-well-known method devised by K. Judd, wherein the assumptions of uniform scaling and the $R \Rightarrow 0$ limit are not required. This method will be described, and results for the correlation dimension changes in the menstrual cycle over a 30 year lifespan will be presented.



Gregory Derry, Physics Dept., Loyola University Maryland

Chaotic Trajectories in Nonlinear Modeling of the Human Menstrual Cycle

A nonlinear mathematical model of the menstrual cycle is presented, using a set of highly simplified assumptions and approximations grounded in the known physiology of the female reproductive endocrine system. One common feature of previous models reported in the literature is that they do not generate the natural variability in the length of the menstrual cycle that is observed in the data. Due to the chaotic trajectories generated, the model presented here does result in variable menstrual cycle lengths, similar to those observed empirically. The model incorporates feedback loops between hormones produced by the hypothalamus (GnRH), the pituitary (LH and FSH), and the ovaries (estrogen, progesterone, and the inhibins), with the negative and positive feedback behaviors modeled by Hill functions approximating observed physiological patterns. The model assumes simple exponential growth of the granulosa cells (with transformation into luteal cells triggered by an LH surge) and programmed self-destruction of the corpus luteum, both modulated by the hormonal environment that they also give rise to. Patterns of hormonal blood concentration throughout the course of each single cycle are computed during implementation of the model, and these compare well with measured values. A number of model parameters (e.g. amplitudes of the feedbacks, GnRH pulse generator frequency, and threshold for ovulation) can be varied to explore their effects on the model behavior. The variability seen in the output of the model, particularly in the menstrual cycle length, suggests that such variability is a natural feature of the system and not a sign of either dysfunction or random environmental influences.

Paula Derry, Paula Derry Enterprises in Health Psychology
Gregory Derry, Physics Dept., Loyola University Maryland

Chaos Theory and the Menstrual Cycle: A New Theoretical Paradigm

It is widely assumed that normal and healthy menstrual cycles occur in a well-defined, cyclically recurring pattern; irregularities in the number of days between one menstrual cycle and the next are either random variation or caused by pathologies like illness or starvation. However, the empirical data show variability through the life span that no current model accounts for. During perimenopause, the transition to menopause, cycles are known to become more irregular, which reinforces the idea that the transition and menopause itself are best explained by pathology or senescence (e.g., an aging ovary is less able to respond to hormonal signaling). However, research in the last 20 years on the endocrinology of perimenopause has had confusing and unexpected results that cannot be explained by a simple cause-and-effect model. This paper presents our rationale for hypothesizing that the human menstrual cycle is the outcome of a nonlinear dynamical system in a chaotic trajectory, and implications for health research and practice if this is the case. We suggest that chaos theory provides a coherent framework that qualitatively accounts for research results throughout the life span and a testable model of the physiological dynamics underlying the menstrual cycle. With regard to health practice, a chaos theory paradigm changes concepts of the distinction between health and disease (for example, between pathology and normal variability), the importance of variability within and between women, open systems, and therefore links to adaptation, lifespan development, and the need for complex explanations of disease.

Paula Derry, Paula Derry Enterprises in Health Psychology

What is the whole? Unresolved Issues In Top-Down Thinking

Two perspectives on understanding nonlinear dynamical systems are bottom up --self-organization emerges from the interaction of elements of the system--and top down --the system influences, constrains, or makes intelligible, patterning of its elements. Top-down thinking implies examining the nature of the whole. This talk ponders issues that arise in describing the whole, that is, in describing a system and its dynamics, especially in biology and psychology. If the whole is more than the sum of its parts, then what is it? If it is a different level of organization, or a different level of analysis, then how should it be described? What kinds of explanation pertain to it? Issues include: the whole as an entity vs. as the observation point of the observer; the meaning of the whole in an open system; are elements irreducible atoms that interact, or does their nature vary with the state of the whole?; teleology and purposiveness and other qualities of living systems; the hidden reductionism in whole-system explanations and when is it useful.

Karen Detweiler, George Washington University.

Exploring Dynamic Co-emergence through Discursive Interaction

The Complex Adaptive Systems (CAS) community has mathematically proven that change emerges as a

process, but has not shown how it occurs (Mitchell, 2009). This longitudinal study of discursive interaction utilized a case study methodology to address the gap in CAS by incorporating the insights of biology regarding vitalism. It explored whether the sociological construct of Habitus could explain the seemingly modest level of emergent change we observe in social systems, which are inherently complex (Buckley, 1998). The case study specifically explored the phenomenon of coemerging change in the context of the US Senate oversight process. The discursive interactions were found to be subtle and often profoundly productive, with clear evidence of multiple forms of dynamic co-emergence.

A. Steven Dietz, Texas State University.
Ralph Gohring, St. Edward's University.
Misty Pagel, St. Edward's University.

Strange Attractor Pull: An Agent Focused Organizational Systems Simulation-Game

Finding Parsimony Strange Attractor Pull, an Organizational Systems Simulation-Game, helps participants experiment with and understand the factors that influence the performance of organizational systems. They can test their ideas and observe the consequences of their various decisions and actions and decide what works and what appeals to them. The simulation-game draws upon concepts from chaos/complexity theory in the physical sciences to explore their application to thinking about organizational systems. The overall goals are to encourage participants to experiment in designing, developing, and testing organizational processes, systems, structures, and relationships, and to reflect on what they have learned after trying them.

John Driscoll, Portland State University.

Fractal Cartography and Reconstructibility Analysis of Portland Oregon

Fractal dimension and urban density, or built-up area, offer metrics to planners and may afford a better understanding of urban growth patterns and facilitate land use planning and regulatory decisions. Here we investigate the combined effects of fractal dimension (F) and density (D) on a diachronic urban environment. Four Types of (F, D) amalgams are introduced and assessed for usefulness in predicting patterns of urban growth. The context for this analysis is spatiotemporal, spanning over four decades in a roughly four square mile section of metro Portland, Oregon. Four specific eras of Portland s history are used: 1948, 1960, 1975 and 1990, defined as A,B,C and D respectively. Scaled grids are overlaid on the sample area and individual cells (lattice sites) are quantified in terms of F and D. Continuous variables F, with $0 < F < 2$, and D, as a percentage of total coverage, are each split into 2 bins. This study defined 4 Types using the binary F and D as coupled measures and tested them for predictive power across 1, 2 and 3 time lags. F was measured using box-counting dimension and D was a measure of building footprint and infrastructure area in number of patches covered / total number of patches for a given cell. Types were: Type 1: (low D, low F), Type 2: (high D, low F), Type 3: (high D, high F) and Type 4: (low D, high F). Type observed frequencies were used to create simplified variable based and state based models with calculated probabilities. F was found to vary relative to lattice size with larger celled lattices producing larger F measures. F measures over 1.6 were not observed. Significant VB models showed that Type for eras A and C at time t predicted Type at era t + 1 with 96.078% and 91.176% correct on the test data respectively. These models were considered very predictive compared to the independence models and suggest Type to be strongly associated across individual time lags A >B and C >D. Type was not found to be associated across eras B and C with a variable based model. State based models were discovered which did have predictive power across multiple time lags including B >C. The best SB BIC model (most conservative) was IV:Ta4Tb2Td2:Tb1Tc4Td3:Tc1Td2:Tc1Td3:Tc4Td4:Td and somewhat simpler than the best performing VB BIC models with 5 degrees of freedom compared to 9 and with an impressive reduction of uncertainty of 22.5%. This study has given evidence that Types are predictive of future urban development in a way that F or D alone are not, such as T4 predicting T3. These results indicate a direction toward a more comprehensive metric.

Matthew Eichler, Texas State University
Constance Porter, St. Edward's University
A. Steven Dietz, Texas State University

Students, Silos and Interdisciplinary Research: Wicked Problems, Heutagogy and Higher Education

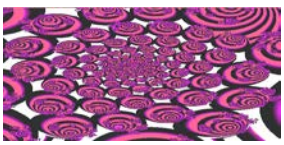
This paper will present challenges associated with developing interdisciplinary research. Today, more than ever, societies are faced with the need to address complex social problems. Societies are increasingly interconnected at economic, cultural, and political levels. Traditional education within universities has fostered degree programs that largely exist within academic silos, single discipline spaces that further a disciplinary perspective to the exclusion of other disciplinary perspectives. Students graduating from these programs tend to continue the discipline of disciplinary practice. In addition many of the students entering higher education

are looking for a broader set of options for addressing the challenges presented them by society. Traditional academic programs do not prepare graduates to work with other disciplines, let alone addressing problems from a trans-disciplinary perspective. When faced with complex social problems (wicked problems), disciplinary trained practitioners try to address problems from a single stance, while other single minded professionals have the same problem from their perspective. In an interconnected, globalized world, problems are too complex for simple solutions. Higher Education needs to develop graduates that are comfortable working in multi-disciplinary spaces and teams to attend to the social problems of the world. Additionally, there is a need for trans-disciplinary thinkers and practitioners. Educational programs can work towards both needs, first in the fostering of interdisciplinary collaboration, and secondly by creating interdisciplinary programs that foster interdisciplinary thinking about complex social problems.

Caroline Fielden, University of Sydney.
Carolyn MacCann, University of Sydney.

The Dynamic Approach Withdrawal Survey (DAWS): A behavioral measure of personality traits.

Despite being frequently used in many forms of psychology research, self-report measures of personality are poorly validated in terms of actual human behaviour. Correlations between self-report measures and behavioural tasks rarely share more than 10% variance, leaving the question of what it is that self-report measures identify an open question. The Dynamic Approach Withdrawal Survey (DAWS) is a behavioural task that is being developed in an attempt to apply a Dynamic Systems approach to this question. It is unique amongst behavioural tasks typically used in personality research, in that it delivers individual time series data, as well as more commonly used measures. An examination of both these commonly used measures (such as mean and total scores), and the time series data from two studies indicate that there are important relationships between the dynamics of individual patterns of behaviour, and self-report measures of personality. This shows that a Dynamic Systems approach offers a means by which the relationships between self-report measures of personality and actual human behaviour can be better understood. This presentation of research will both summarise these findings, and consider the challenges ahead.



Bentley Fink, Graduate Student, Texas State University.

Stirring Up the Silt

Gallaudet University, the World's only Liberal Arts university for the Deaf, is a complex institution, being open and funded by the Federal government. With the Federal funding comes oversight from none other than the Congress. The nature of the University institution, coupled with the oversight from the Federal government, demands that it be run as efficiently as possible, as orderly and stable as possible. But what happens when a crisis suddenly appears out of nowhere that threatened to do more harm to the University than good? When the University"s Chief Diversity Officer was found to have signed her name on a same-sex marriage referendum, a chain of events was sparked that tested the University"s ability to handle a crisis. This presentation takes a look at how Gallaudet University, as a complex adaptive system, displayed its system fitness in dealing with the presence of a suddenly-appearing attractor, and how the University transitioned from the edge of chaos to complex/chaotic state and back.

Stephen Guastello, Anton Shircel, **David Poggi**, **Matthew Malon, Paul Timm**, **Kelsey Weinberger**, **Katherine Reiter**, & **Megan Fabisch**, Marquette University.

Cusp catastrophe models for cognitive workload and fatigue: A new paradigm for studying biases in financial decision making

This study evaluated the impact of cognitive workload and fatigue on optimization performance and risk-taking in financial decisions. The research paradigm invoked the use of two cusp catastrophe models which had previously proven useful for separating workload and fatigue effects of other types. Participants were 299 undergraduates who completed a series of tests and a financial decision making task that escalated in workload as it progressed, and which required the participants to work in one of three speed conditions. Results supported the cusp for workload with conscientiousness and self-control as bifurcation factors in optimizing, and field dependence and work ethic as bifurcation variables in risk tasking; speed and load were the asymmetry variables. Results also supported the cusp for fatigue with work completed and work speed as bifurcation factors for both optimizing and risk-taking; field independence was the asymmetry variable for both dependent measures, and performance on an anagram test was another compensatory ability that inhibited risk-taking. In addition, a reflection effect was observed as load increased if the choices were confined to potential

gains, and greater risk-taking if potential losses were also present.

Stephen J. Guastello, **Katherine Reiter, Anton Shircel**, **Paul Timm**, **Matthew Malon**, & **Megan Fabisch**, Marquette University

The Performance-Variability Paradox, Financial Decision Making, and the Curious Case of Negative Hurst Exponents

This study examined the relationship between performance variability and actual performance on financial decision makers who were working under experimental conditions of increases workload and fatigue. The rescaled range statistics, also known as the Hurst exponent (H) was used as an index of variability. Although H is defined as having a range between 0 and 1, 45% of the 172 time series generated by undergraduates were negative. Participants in the study chose the optimum investment out of sets that were presented in each one of a series of 350 displays. The sets of options varied in both the complexity of the options and number of options under simultaneous consideration. One experimental condition required participants to make their choices within 15 sec, and the other condition required them to choose within 7.5 sec. Results showed that (a) negative H was possible and not a result of psychometric error; (b) negative H was associated with negative autocorrelations in a time series. (c) H was the best predictor of performance of the variables studied; (d) three other significant predictors were scores on an anagrams test and ratings of physical demands and performance demands; (e) persistence as evidenced by the autocorrelations was associated with greater time pressure. It was concluded, furthermore, that persistence and overall performance were correlated, that healthy variability only exists within a limited range, and other individual differences related to ability and resistance to stress or fatigue are also involved in the prediction of performance.

Michael Halasz, NIH health scientist administrator (retired)

”Visual Field Mapping” in a medical ophthalmic clinic. Systems diagrams are drawn connecting steady states through transient chaos

Hancock (2013) American Psychologist recently addressed a major problem arising in such laboratory settings as medical Diagnostic Visual Field Mapping or, indeed, psychophysical measurement in general. One cannot fully ascertain the extent to which results are a product of the test subject or a product of the tester. It’s with this critique in mind that I attempt to system model a traditional ophthalmic clinic in the process of transitioning to a more modern state and structure. The target ophthalmic clinic is located within a major medical center, itself undergoing transformation by technological advance. If one would be addressing that greater institution, one could think of fractals. Its diagram could be rendered as a simple linear one depicting patient flow from intake to exit with successive processing gates or “stations” of ascending expertise and hierarchic powers: at intake, clerical staff checking patients’ means; at second gate, OD optometrists, applying standard visual acuity tests and measuring intraocular pressure. At the third level, “Visual Field Mapping,” whose clinical importance lay in technical measurements of glaucoma or detached retinas. In the old order of things, a lower-level technician “ran” the visual field machine whose stored data would be forwarded to the ophthalmologist. But this would in fact turn out to be the station at which old technician roles would be widened as top ophthalmologists came to realize that personal discussion between patients and technicians would yield valuable clinical information for themselves, thus opening up new flow channels. Thus the system modeler must draw an irregular trajectory of transient chaos between the clinic’s two stable steady states.

Marna Hauk, Prescott College and Institute for Earth Regenerative Studies.

Leaf, Fire, River, Hive, and Storm: Catalyzing Regenerative Education in Small Group Collaboration Through Complex Ecological Fractals

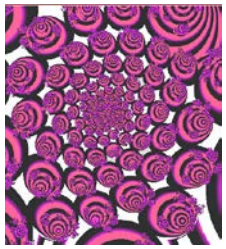
The current moment in biocultural and planetary realities requires thinking and education for thinking that is creative and regenerative. Processes and patterns from nature offer living templates for creative and regenerative thinking. Biomimicry and complexity meet in a set of recurring, self-similar patterns across scale that can perturb innovation in educational design. Situated inside of the growing body of thinking extending complex adaptive systems and fractals from chaos theory into educational theorizing, this research develops a set of ecofractals for use in educational contexts and educational design. This article overviews mixed methods original educational research sparked by five archetypal fractal patterns from nature, including leaf, fire, river, hive and storm (more generally, branching, radiance, flow, packing, and vortex). Over a two-year period of study, ecological fractals in design charettes, creative divergence, and collaborative design exercises produced more creative, ethical, and regenerative designs across scales. This research suggests that regeneravity beyond sustainability may

be an emergent property of engaging complex adaptive and living systems and ecological fractals approaches in classroom and educational system design.

Marna Hauk, Prescott College and Institute for Earth Regenerative Studies.

The Earth Beyond Sustaining: Assessing and Designing for Regeneration by Developing the Transdisciplinary Regenerativity Index

As suggested by the Gaia Theory, the planet self-organizes as a nonlinear dynamic system(s). Although, for some, sustainability is sufficiently aspirational, alternate models such as resilience and regeneration can offer more self-organizing, restorative models for human systems and for nature-culture symbioses. In an effort to develop complex guidelines for designing and assessing in alignment with the autopoietic regeneration of the planetary system, this research shares the first two iterations of the development of a complex Transdisciplinary Regenerativity Index. Using a method of complex meta-synthesis, the Transdisciplinary Regenerativity Index sifts through fifty-plus multi-factor models of regenerativity and over 600 attributes to surface a distilled set of descriptions of regeneration. Of the regeneration sources developed in Iteration 1 and Iteration 2 factor syntheses, disciplines represented include law, medicine, psychology, economics, education, evolutionary biology, architecture, landscape management, the arts, and social theory, along with transdisciplines such as regenerative design, complexity, and living systems theory. The research includes a discussion of initial approaches to scoring using these integrated transdisciplinary regenerativity descriptions and factors. This work is significant both in its response to the call for attention to planetary challenges that are transdisciplinary in nature (Montuori, 2005), as well as for its methodological innovations in generating complex meta-syntheses with practical applications. Initial scoring of mixed methods work products and subsequent tuning to the Transdisciplinary Regenerativity Index reveal some of the emergent issues with complex methods of systems-scale assessment and design. Beyond sustainability, this index holds promise as an educational catalyst for the emerging generation of systems thinkers and designers facilitating self-organizing planetary regeneration.



Eric Hessler, Department of Psychology, University of Minnesota Duluth.

Direction of Attention Influences Relative Phase Performance in Interpersonal Coordination

In motor coordination, performance tends to be attracted to the inphase pattern. Defined perceptually, inphase is movement in the same direction at the same time. In reality, attraction to perfect inphase performance is really only a property of symmetric oscillators like two index fingers. Attraction to inphase may be exhibited but offset by differences in the natural frequency of the coordinated components, handedness, and where attention is directed. The focus of the current study was to examine how direction of attention influences interpersonal coordination. Right-handed participants sat side by side and coordinated movement of their hands. The left participant used the non-preferred hand and the right participant used the preferred hand. Participants focused their attention toward three locations: left participant's hand, straight ahead, and right participant's hand. Coordination deviated from inphase when attention was directed to either hand. When participants looked left, the right participant's hand slightly led the left participant's hand. When participants looked right, the opposite pattern occurred. In a second study, a dowel was placed in front of each participant's hand to test peripheral vision. Participants focused attention toward the top of a dowel, rather than directly at a participant's hand. The influence of direction of attention on performance was similar to the first study. Those results suggest that overt and peripheral attention can influence coordination between two people. When attention is directed toward another person s movement, there is a fixed point shift (a shift in attractor location) away from perfect inphase coordination.

Gus Koehler, Time Structures, Inc

Complex Systems are Relational Space

Space, like time, is a concept that we think we understand as we work on chaos and complex systems work until we are asked to define it and then we must say, like Augustine, that we don t really know what it is (Confessions, 11.14.17). Albert Einstein cautions that scientists make use of a whole arsenal of concepts so readily accepted as to be almost imbibed with their mother's milk. These concepts are taken to be something obvious, immutably given, having an objective truth value hardly ever seriously doubted. This unconscious commitment can be a hindrance where the consistent use of such traditional fundamental concepts

like space leads us to foundational paradoxes that may be difficult to resolve in a new discipline like ours. Examples of paradoxical difficulties. Network theory defines a complex system by its nodes and edges seemly suspended or frozen in 2D or 3D space. This concept of space strips away the dynamism at the heart of social networks or of the genetic activity of biological systems like c-elegans. Ironically, a logical explanation proceeds as if we construct it from a distance in a kind of consciousness space. As a construct of consciousness it cannot explain itself since it is itself. The mathematical construction of phase space is taken to be indispensable to chaos theory and is accepted as a body of truths about independently existing entities like attractors. In contrast, Field argues that mathematics is dispensable, and should be considered as a body of falsehoods not talking about anything real. He started with the concept of "betweenness" to characterize space without coordinatizing it, adding extra relations between points so that no special mathematical objects are needed at all. Two alternative concepts of space are offered to unpack these paradoxes. The first conceives of a complex system as a patterned and inherently continuous relational transformation due to its very disposition to do so. Explanation involves interpreting complex systems solely from the perspective of a single propensity producing processes in motion. The second, attempts to deal with the paradox of consciousness trying to explain itself, which includes the possibility of a relational, non-coordinated concept of space. Here we will draw upon the work of Longchen Rabjam. By the end of this examination of the concept of space a much enriched foundation may be possible for explaining the dynamical operation of complex systems.

John Kolm, CEO, Team Results USA.
Leslie Gruis, PhD (NorthWestern), consultant.

Crocodile Charlie's Challenge

A game-theoretic model for nonlinear decision outcomes in a simulated leadership environment is described which unifies some ideas of both chaos theory and classical statistics using methods from number theory, and a practical example is demonstrated. The aim of this work was to specify design parameters for nonlinear decision models that have well-defined statistical properties. A number-theoretic model based on partial integer sums was used to simulate nonlinear dynamics in leadership decisions, and the properties of this model are described both through behavior and theory. The outcome is a playable game which allows nonlinear outcomes to be simulated within the boundaries of frequency-distribution properties that can be fully controlled. This work offers a model for generalized simulations of nonlinear, chaotic-seeming decision outcomes within a classical statistical context and can act as the basis for playable training games and the controlled academic study of chaotic boundaries in work teams. A number of empirical parameters for conditioning such a model are also discussed. Attendees at this session will be directed to a playable, online version of the sample game at the end.

Matthijs Koopmans, Mercy College.

Daily Attendance Rates in One Urban High School: Three Analytical Viewpoints

Given that many teenagers drop out of high school before graduating, it is surprising that there is so little empirical work to describe high school attendance patterns. At most, average daily attendance rates are reported for individual schools over a yearly period. The purpose of this analysis is to begin to gain a better understanding of how daily attendance patterns behave over time. The fact that some urban school districts now maintain record of daily attendance rates in their schools creates an opportunity to do so. This presentation discusses daily attendance in one high school over a seven-year period (n=1,345 observations), and utilizes three analytical approaches to address the question whether there are short-term and long-term dependencies in daily attendance patterns. Autoregressive Integrated Moving Average (ARIMA) models indicate the presence of short-term cycles (daily, weekly) and a significant impact of outlying observations on the series. Power spectra suggest self-organized criticality in the original series, but not in the residuals of the ARIMA models estimating short term dependencies. The maximum Lyapunov exponents are significantly different from zero, regardless of whether short term dependencies are modeled or not, suggesting sensitivity to initial conditions in these data. The possibility of chaos in daily attendance helps appreciate the potentially destabilizing effect of exogenous processes on the attendance trajectory (e.g., extreme weather events, economic downturn). The conflicting results with respect to the power laws qualify the conclusion that there may be self-organized criticality in the system. Limitations of the analysis are discussed.

Jouke Kruijer, Artist and Management Consultant, Private Practice, The Netherlands.

Nonlinear Dynamics in Creative Processes: Towards a New Leadership Practice

Understanding the role of creativity is increasingly important for leadership development. Leaders need to learn how to facilitate organizational change that diverts from traditional practices. If they are to change the way they change, they need to understand complexity and

the role of nonlinear dynamics. This workshop aims to show what role nonlinear dynamics have in creative processes. The workshop was designed as part of a value creation intervention for large corporate organizations. Groups varying from 10 to 450 employees collaborate on paintings of various shapes and sizes. We found that the nonlinear dynamics of these events showed how boundaries, differences and feedback loops set off a group to self organize in artistic endeavor. We also found that throughout the process adaptive action was taken by the members of the group to release the build-up of tension arising from the conditions that were set for making a work of art. Coherent patterns emerged and disappeared into dissipative structures. These bifurcations resulted from reducing exchanges, amping or damping differences or shifting and opening containers. This workshop is intended as a learning experience for those that look for ways to find a concrete portal for organizations to have their members understand, experience and ultimately accept unpredictability, interdependency and emergent behavior as natural features in the corporate landscape.

Malcolm D. Lowe, Independent Researcher

Languages Encode Meaning and Grow on the Basis of Hidden Design Features

It is an undisputed fact that the biological world encodes information in nature and that this phenomenon is not random. My research shows that the same is true of language and languages. Notwithstanding appearances to the contrary, there is an implicit order behind the apparent chaotic jumble of sounds and meaning in any given language. Unfortunately, the dominant paradigm in linguistics for the past three hundred years or so has systematically denied that such an order exists, with the devastating result that we are still no closer to understanding the true nature of language or how this most important attribute of man came into being. When viewed from a holistic perspective, languages are shown to be complex coherent meaning systems which grow according to a very precise logic and exhibit self-similar structures at every level in the structural whole. Specifically, my research shows that the English language starts out from molecular sound/meaning units in its proto-language stage (with diffuse meanings based around Oneness). These later combine into clusters to form words. In the next stage of growth, words form larger fields of meanings defined by a generic determinative sound at the beginning of the word. These fields are then woven together to form the language as a whole. Each layer of the language so laid down becomes a time marker in the diachronic development of the language. These design features are in part difficult to see because they are embedded within the architecture of language. However, by far the most important reason they have not been discovered until now is that we have not been looking for them. Although it is more difficult to follow the evidentiary trail of these design features because meaning is generated in the unconscious, it is not impossible. I was able to access these embedded design features by implementation of a novel methodological approach which recognizes that while a computational logic operating behind the scenes to make meaning cannot by definition be the object of direct inquiry, the study of the projection of those design features as manifested globally across the spectrum of meaning in the form of words provided an alternate point of access. What is particularly exciting to me about the theoretical constructs described in this paper is that the embedded structures may potentially allow us for the first time to map the architecture of language onto the physical network of neuronal circuits in the brain. This is because the organic growth patterns of language are more likely to be functionally aligned with the neuronal structure of the brain than are the baroque syntactic structures studied by linguists today. Although at the present time the tools we have for analyzing the brain in situ are not refined enough to provide a reliable method of either proving or disproving what is written here, I am confident that in time advanced fMRI and other brain scanning methods will confirm the results of my research. In the meantime, I believe that the ideas presented here offer a way forward where other avenues of inquiry appear to be permanently blocked.

Wander Lowie, Department of Applied Linguistics**,** Center for Language & Cognition, University of Groningen.
Rika Plat, Center for Language & Cognition, University of Groiningen.

1/f Noise in Second language Word Naming and Semantic Processing

Do we read for meaning when we are reading aloud? And are there differences between first language (L1) and the second language (L2) reading in this respect? We investigated these questions using spectral analyses and fractal dimension analyses on the response times of a word naming experiment. Earlier studies using spectral analyses in L1 word naming data clearly showed 1/f noise in the data (Van Orden, Holden, & Turvey, 2003), indicating automatization of the task. However, this effect may be due to automized mechanical reading, in which no semantic processing takes place. In our study, we have therefore added a condition in which the participants were forced to process the words semantically. 26 Advanced Dutch learners of English carried out word naming tasks in their L1 (Dutch) and

their L2 (English). These participants were randomly assigned to two conditions. One group read words similar to the task in Van Orden et al.; the other group had to push a button when the word belonged to a particular semantic category, thereby forcing semantic processing. We hypothesized that semantic lexical processing is less automatized than non-semantic lexical processing (more white noise). We also hypothesized that reading in the L2 would be less automatized than reading in the L1 (more white noise). The results showed differences in 1/f noise between the conditions in the direction of our hypotheses.

Keith Owen, Somerset Consulting Group.
A. Steven Dietz, Texas State University.
Norvell Northcutt, University of Texas.

PathMapping

PathMapping as a cost effective a tool for issue identification and analysis of issues that are relevant to organizational transformation and change. While qualitative in its nature, PathMapping was designed to overcome many of the weakness of traditional qualitative methods including the lack of generalizability and concerns about the validity of findings. PathMapping is an algorithm for generating, analyzing, and interpreting qualitative data that can be applied to many areas, particularly those in which the exact nature of the problem or issue is not well known and analysis of the problem involves the social construction of meaning. We will present two case studies in which PathMappimg was used to understand the culture of two very different organizations. In addition, we demonstrate the basic process used in the PathMapping process.

Derek Paar, Springfield University, Springfield, MA.

Pragmatic Negations: Making Sense in A Universe That Is

So, here we are settled down in this magnificent mess of universe - an infinite universe all the way down and out, a universe with no dead spots, a universe of chance-change-motion-and-connection. A universe that might as well be one never-ending Mandlebrot island of a place. And somehow we manage to make some sense of it and navigate our way through it. I believe that we do this by way of three principles: Knowing is No-ing (we make sense of a thing by negating that which it is not), Confusion Precedes Creation, and Confusion is Not No-ing and is obtained by either no-ing too much (making a thing too exclusive) or no-ing too little (making a thing to inclusive). These ideas will be used to understand change, creativity, psychotherapy, empathy, law, issues in social psychology, and education.

David Pincus, Chapman University.
Kiersten Eberle, Chapman University.
Christin Walder, Chapman University.
Aaron Kemp, University of California, Irvine.
Curt Sandman, University of California, Irvine.
Mohammed Lenjavi, University of California, Irvine.

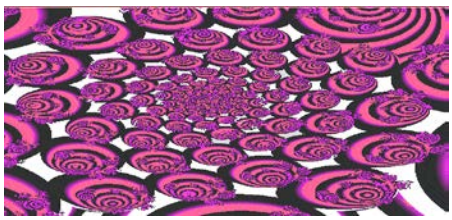
The Role of Self-Injury in Behavioral Flexibility and Resilience

Severe and persistent self-injurious behavior (SIB) is notoriously difficult to understand and to treat. The current study used self-organization theory to investigate the impact of SIB on behavioral flexibility and resilience. Data consisted of categorical time-series of sequential behaviors from individuals with developmental disabilities and severe SIB. Results showed evidence for self-organization in behavior patterns. Series including SIB were more flexible than those without SIB. On the other hand, the number of SIB events (perseveration) was associated with behavioral rigidity and structural disintegration. Finally, there was evidence that behavioral flexibility changes pre- and post-SIB. These results may provide a deeper and more theoretically grounded understanding of why self-injury is so difficult to understand and to modify using the traditional behavioral paradigm. Future prevention and intervention for SIB may improve by more investigation focusing on the role of SIB in regulating levels of behavior-environment flexibility.

David Pincus, Chapman University.

Experiential Balancing Therapy: Case Conceptualization and Treatment Planning

Experiential Balancing Therapy (EBT) is an integrative approach to psychotherapy based in Complex Adaptive Systems Theory. The approach is able to account for theoretical constructs and techniques from each of the major empirically supported approaches to psychotherapy, ranging from behavioral to psychoanalytic. The goal of this short workshop is to apply the EBT framework to case conceptualization and treatment planning using one or two case examples. Attendees are welcome and encouraged to bring in their own cases for this purpose if they would like.



Dora Raymaker, Portland State University, Systems Science.

Leveraging the Dynamics of Science, Policy, and Community for Systems Change

The relationship between science, public policy, and community generates nonlinear feedback that often reinforces dominant culture and priorities, and increases discrimination, or even harm, toward marginalized populations. This process can be both difficult for people to recognize, and difficult for them to influence, due to its tightly coupled, highly complex interaction of components. With examples drawn from public health research and policy, this paper aims to explore the mechanism of nonlinear feedback between science, policy, and community, and offer suggestions for effectively leveraging change. The analysis takes a systems thinking approach and begins with the premise that structure generates behavior; it then considers the multiple perspectives of scientists, policy makers, and community activists, as well as historic data, to develop a system dynamics model and identify points of leverage. These points of leverage then suggest ways scientists can change the nature of existing structures to better empower individuals and communities, and break marginalizing or harmful feedback cycles. The discussion gives particular attention to the use of community-engaged practices such as action research and community based participatory research which explicitly change the nature of the feedback between scientists and communities, and which have been shown effective in practice. While the broader structure of large, complex social systems are by nature difficult and slow for people to change due to their high degree of nonlinearity, there exists evidence that by leveraging the existing dynamics between science, policy, and community in new ways, we can effectively generate deliberate and impactive systems change.

Ruth Richards, Saybrook University.

Chaos Theory And Creativity

From the mystery of creative insight to creative shifts in groups, what can nonlinear dynamics—metaphorically at minimum—tell us about the psychology of creativity, and even about our higher human possibilities for growth and transformation? Can it reveal new insights about The “Four P’s” of Creativity (process, product, person, and press of the environment) and how we might enhance creativity in ourselves and others? Some interesting possibilities are addressed. Here the focus is on “everyday creativity” or our “originality of everyday life,” which is fundamentally human and present (to some extent) in everyone. Some say it is becoming increasingly important to the course of human evolution. This talk not only includes didactic material but a couple of exercises one can try for oneself.

Diane Rosen, State University of New York.

Invoking the Muse: Dada’s Chaos

Launched in 1916, Dada was a (non)movement that produced (anti)art. Coincidental with the rise of Freud’s theory of the unconscious, writers and artists in this loosely knit group rejected narrow traditions of bourgeois capitalist society, preferring artistic expression that undermined logic and embraced chaos. Nearly one hundred years later, nonlinear dynamical systems theory gives renewed currency to Dadaist techniques for invoking the creative muse. In this metaphoric model, creativity is dynamic behavior within an open system involving person, process, product and press (environment or context), characterized by sensitive dependence on initial conditions (person, press); diverging but constrained trajectories and unpredictable nonlinear linkages (process); and self-organization (products). Over time, fluctuating solutions (iterated functions) converge in two fundamental strange attractors: the pleasures of novelty and fitness i.e. an intuitively suitable balance of antinomies. This dialectic relationship, innervated by reciprocal engagement in the playing fields of deterministic chaos, is fundamental to creativity. Hierarchical reasoning is an often-enervated problem-solving space; nonlinear trajectories, however, incite creative ideation in a dynamic phase-space of de-partitioned memory, cognition, intuition and perception. There, between familiar and strange, improvisatory play enlivens nascent interconnections and indeterminacy fuels surprising combinations. Working with and from this tension of uncertainty allows being nowhere and everywhere, having a goal yet wandering, having no single way and therefore access to all ways. Using my own Dada-chaotic process, this poster proposes that such a perspective enhances the synergy between what is and what could be, and thereby invigorates creativity across disciplines

David Schuldberg, Psychology, University of Montana.

Nonlinear dynamics in studying creativity

The 2000 s have seen important applications of chaos theory to the study of creativity, as well as emotions, dynamical diseases, psychopathology and the relationships among them. With continued study of everyday creativity, and of the ubiquity of nonlinearity and chaos in mundane things like heartbeats and coping, there has been a move from insights of dynamical systems metaphors to rigorous application.

This paper illustrates a Somewhat-Complicated Systems (SCS) approach to creativity in both modeling and data-analysis. It describes creative systems at four different levels: As mechanisms, processes, trajectories, and through attractors in phase space. These four systems perspectives provide new directions for theory and empirical work on creativity. First, the talk will show how relatively simple nonlinear mechanisms provide useful insights into novel and mathematically complex behavior, and it provides an example of a toy model based on curvilinear links between psychopathology and everyday creativity. It covers how small-scale bivariate relationships, such as those linking affect and problem solving, can be translated into process terms. Third, it describes time series or trajectories of creative activity. Finally, the talk argues for the perspective of phase space representation, where temporal progressions and narratives are examined for patterning and attractors, including fractal structure. The concept of stability in dynamical systems in its diverse mathematical forms -- can provide new understandings of creativity, genre, and style. To illustrate these points, the paper reviews several models and datasets, including re-examining the well-known fluctuations in Franz Schumann s mood and musical output.

Lisa Taylor-Swanson, *Symposium Chair*
University of Washington, School of Nursing
Mary Koithan, University of Arizona, College of Nursing
Lisa Conboy, New England School of Acupuncture
David Pincus, Crean School of Health and Life Sciences, Chapman University
Iris Bell, The University of Arizona, College of Nursing.

Applications of Complex Adaptive Systems in Complementary and Integrative Medicine Research

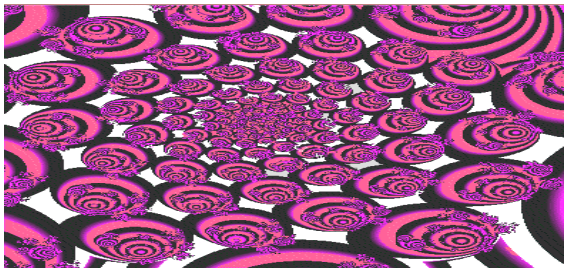
Complex adaptive systems (CAS) is a meta-theoretical framework that can be used to study open, emergent and information-exchanging phenomena, including weather patterns, social life and medical interventions. Complementary and integrative medicine (CIM) is an emerging field of complementary therapies (therapeutics that are not allopathy) and integrative medicine, a view that care of patients should focus on body-mind-spirit healing and wellbeing. CIM includes therapeutics such as homeopathy, Traditional Chinese Medicine (TCM) and Integrative Nursing that are well-suited to the application of CAS as a framework for research design. CIM therapeutics share a worldview of emergence, interconnectedness and are composed of interventions that are complex and change over time.

In this symposium, *we will present both theoretical and empirical work that provides value to the field that is cutting-edge in applying CAS to CIM*. David Pincus will first present an overview of CAS in understanding biopsychosocial wellness and resilience. This segment will focus on nonlinear research methods and empirical models that may be used to test the impacts of CIM interventions. In addition, some general applied principles will be presented based on these nonlinear models.

This will be followed by a presentation by Mary Koithan on the study of Homeopathy. Homeopathy, a 200-year-old system of alternative medicine, views the patient as an interconnected nonlinear network. Healing occurs from above downward, from inside out, and in reverse order of time of appearance of original symptoms. This system asserts that suppressing local symptoms will simply lead to emergence of different symptoms in other parts of the body. Qualitative studies reveal that patients experience a dynamical change process described as "unstuckness" as well as transient worsening early in the course of treatment. Next, the Mary Koithan will present about the emerging discipline of integrative nursing defined as a way of being-knowing-doing that advances the health and wellbeing of people, families, and communities by care that is person-centered and relationship-based. Embracing basic tenets of complex systems science, integrative nursing interventions provide information to the human-environmental complex system that support the person's emerging patterns of health-wellness. Rather than attempting "fix" someone identified as ill or broken, integrative nursing recognizes interventions are to provide information to a complex human system to alter or offer alternative ways of being-in-the-world. Linked to nursing's theoretical past, CSS provides a meta-theoretical perspective that can inform nursing science and methodological approaches to safety/quality outcomes research questions.

Lisa Taylor-Swanson will then present on Traditional Chinese Medicine (TCM), which is characterized by an intricate theoretical framework that is emergent and changing over time. CAS properties of self-similarity, complexity, emergence, and self-organization may be illustrated with TCM theory. Therefore, it seems merited to study TCM with CAS.

Lastly, Lisa Conboy will discuss preliminary results from a recently completed study of TCM treatment for the symptoms of the Complex Medical Illness, Gulf War Illness. Various modeling ideas of this rich data set, which includes Western, and TCM variables, as well as biomarkers, will be discussed.



Ken Ware, Neurotricional Sciences Pty.
Victor Popov, Queensland Sports Medicine Centre.
Sara Nora Ross, Antioch University.

The Body's Nonlinear Genius: Cases of Serious Disabilities Dramatically Improved by the Same Neural Dynamics Therapy

After winning a 2012 world championship, a triathlete s right hip became severely inflamed; it was impossible to run and painful to train on his bike. Defending his title in 2013 was at risk when traditional physical therapy failed to help. A nonathletic adult with Graves disease faced a third discectomy (back surgery) when she could no longer stand or walk. In each case, traditional treatments did not improve disabling conditions. When these individuals used the unique Ware K health trigger process a self-healing neural dynamics therapy there were radical positive effects. The athlete s performance was recovered and enhanced. The other adult moved normally without surgery and Graves disease indicators were gone after six weeks. These results were consistent with 25 years of such therapeutic benefits across a wide range of disorders, diseases, and injuries. We compare the assumptions and methods of traditional physical therapy and discectomy with the assumptions and methods of the Ware K therapy to account for therapeutic differences. Against that background, we introduce demonstrations of the method and the theoretical explanation for how the body self-organizes its tailored self-healing.

Rita M. Weinberg, National Louis University.

Theories About Effectiveness of Energy Therapies

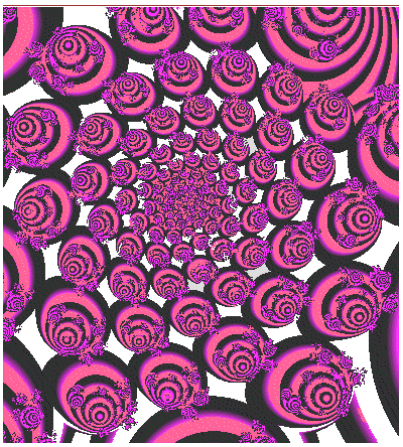
As a long time psychotherapist, I have used a number of different types of therapy. For the past 15 years my preferred form of treatment has been Thought Field Therapy. This is one of a group of therapies modeled largely on the principles of Acupuncture, which has been used for hundreds of years. These therapies are called energy therapies. They are both rapid and effective. In this paper we explore treatment from several different theoretical perspectives. How do they work so quickly and so well? How do they clear up such a wide variety of psychological problems including very serious ones such as PTSD. We explore the many similarities with Chaos Theory principles. We will look at neurology and its role in facilitating rapid and effective healing. Theories from biology also enhance our understanding about interacting systems and their role in this process. Finally we turn to information Theory to help us understand the significant and expanded role information contributes to the success of the energy therapies. Theories about the way dynamic systems operate include both Chaos Theory and Thought Field Therapy, Each deal with systems, with changes which take place and with the role of attractors and paradox. We look at input and output(the butterfly effect) as well as other aspects in comparing Chaos Theory and Thought Field Therapy. We discuss several recent reports of success with a wide assortment of population and problems. Neurology plays a role in psychological therapy. We indicate recent research on the role of the amygdala, how it operates, and the nature of transition from severe psychological problems to healing and health. We explore additional biologogical perspectives of how such processes may influence and facilitate treatment success. Information Theory plays an increasingly significal role in response to these same questions. We look at its role in energy therapy. Taking a broad view of several different theories and systems could bring us a long way to increased understanding of this method of psychotherapy. That, in turn, could lead to assistance and planning of more effective outcomes.

Justin Williams, Texas State University-San Marcos.

Toward a Symbiotic Ethic: Potential emergence out of agent-based environmentalism

This paper seeks to examine the organizational dynamics involved in forming an environmental ethic. It deals with some problems detailed in game theory specifically emergent cooperation vis-a-vis other problems within boundary setting. Given the reality of our systems dependence on relatively finite resources, independent agents such as non-profit organizations, NGO s, governmental agencies, as well as first nations become required to forge strategic alliances to determine policies of conservation, preservation, and resource management. Symbiotic relationships in non-human systems provide an interesting source of evidence to consider while exploring the organizational dynamics within human systems. Evolutionary game theory has provided insight into the benefits agents experience within cooperative relationships. Furthermore the problem of altruism seems to be an emergent phenomenon, yet ubiquitous throughout living systems. When cogitating how we are to forge an environmental ethic it may be wise to consider the nature of certain non-human boundary setting characteristics vis-à-vis organizational dynamics. Thus, given the evidence which suggests the vibrancy of open systems; it may be incumbent upon us to mimic such characteristics of symbiotic relationships when organizing groups to develop strategic alliances. In many ways these bonds that form may develop a normative epistemology when it comes to conventions deemed necessary for the

success of these organizations as well as the potential ethic that emerges. It assumes that when forming an environmental ethic for the next generation, the agents involved will have shared benefits as well as mutual goals. Given these conditions this paper seeks to explore conditions and further some suggestions on how we might develop an environmental ethic.



Toru Yazawa, Tokyo Metropolitan University.

Measurements of stress by heartbeat analysis: an empirical work of DFA, both in animal models and humans

Background: Lobsters, insects, frogs, and humans, in any organisms that have the heart, their hearts are governed directly and dynamically from the brain, called the autonomic nervous system. Because the brain responds to external and internal environments in a reflex manner, the heartbeat rhythm (or heartbeat fluctuation) reflects the reflexive changes in the brain. For example, stress/fear can change the heartbeat rhythm. Aim: Focusing our attention on this brain-heart system and recording electrocardiogram (EKG) from freely moving specimens, we studied how stress affects the heart. Methods: We analyzed EKG and heartbeat fluctuation by a method, Detrended Fluctuation Analysis (DFA), introduced by Peng et al. (1994) modified by Scafetta and Grigolini (2002). Results: In animal model heart experiments, relaxed lobsters in a shelter exhibited a normal scaling exponent of 1, and lobsters receiving handling-stress from human, exhibited a lower scaling exponent of = 0.5-0.7. In human hearts, deprivation of sleep, PVC arrhythmia, alternans arrhythmia, job-related stress, lowered the scaling exponent, about 0.7. The hearts having partially injured muscle cells exhibited a high scaling exponent of = 1.2-1.5. Conclusions: Everyone has different set of DNA. No individual is ever the same. We must inspect subjects one by one. However, we concluded that stress is measurable in most specimens by using DFA.

Todd Zorick, Psychiatry, University of California, Los Angeles.
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Multifractal detrended fluctuation analysis of human EEG: preliminary investigation and comparison with the wavelet transform modulus maxima technique

Recently, many lines of investigation in neuroscience and statistical physics have converged to raise the hypothesis that the underlying pattern of neuronal activation which results in electroencephalography (EEG) signals is nonlinear, with self-affine dynamics, while scalp-recorded EEG signals themselves are nonstationary. Therefore, traditional methods of EEG analysis may miss many properties inherent in such signals. Similarly, fractal analysis of EEG signals has shown scaling behaviors that may not be consistent with pure monofractal processes. In this study, we hypothesized that scalp-recorded human EEG signals may be better modeled as an underlying multifractal process. We utilized the physionet online database, a publicly available database of human EEG signals as a standardized reference database for this study. Herein, we report the use of multifractal detrended fluctuation analysis on human EEG signals derived from waking and different sleep stages, and show evidence that supports the use of multifractal methods. Next, we compare multifractal detrended fluctuation analysis to a previously published multifractal technique, wavelet transform modulus maxima, using EEG signals from waking and sleep, and demonstrate that multifractal detrended fluctuation analysis has lower indices of variability. Finally, we report a preliminary investigation into the use of multifractal detrended fluctuation analysis as a pattern classification technique on human EEG signals from waking and different sleep stages, and demonstrate its potential utility for automatic classification of different states of consciousness. Therefore, multifractal detrended fluctuation analysis may be a useful pattern classification technique to distinguish among different states of brain function.